

CLAIMS

What is claimed is:

- 5 1. An apparatus for introducing a light beam into a pupil of an eye of a viewer, to thereby project an image onto a retina of the eye, the apparatus comprising:
- a light beam generator for generating and outputting a light beam corresponding to the image;
- 10 a scanning device for scanning the light beam output by the light beam generator;
- a guiding device for guiding the light beam scanned by the scanning device toward the pupil; and
- an angle modifying device for modifying a pupil incident
- 15 angle at which a center line of a scanning angle of the scanning device enters the pupil.
2. The apparatus according to claim 1, wherein the angle modifying device is disposed at a position within a path
- 20 extending from the scanning device to the guiding device, the position having an optical conjugate relationship with a position of the pupil.
3. The apparatus according to claim 1, wherein the
- 25 angle modifying device includes:
- a first modifier for modifying the pupil incident angle with respect to a first modifying direction; and

a second modifier for modifying the pupil incident angle with respect to a second modifying direction intersecting the first modifying direction.

5 4. The apparatus according to claim 1, wherein the scanning device includes:

 a first scanner for scanning the light beam in a first scanning direction;

 a second scanner for scanning the light beam scanned by
10 the first scanner in a second direction intersecting the first scanning direction; and

 a relay optical system for introducing the light beam from the first scanner to the second scanner, such that the first scanner and the second scanner have an optical conjugate
15 relationship therebetween.

 5. The apparatus according to claim 4, wherein the angle modifying device and the second scanner have an optical conjugate relationship therebetween.

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 6. The apparatus according to claim 1, wherein the guiding device includes:

 a mirror arranged in front of the pupil; and

 a relay optical system for introducing the light beam
25 scanned by the scanning device into the mirror, such that an exit position at which the light beam exits from the scanning device and a position of the pupil have an optical conjugate

relationship therebetween.

7. The apparatus according to claim 1, wherein the angle modifying device includes, a mirror arranged at a position
5 having an optical conjugate relationship with a position of the pupil, and the apparatus further comprising a relay optical system for introducing the light beam scanned by the scanning device into the mirror, and wherein an exit position at which the light beam exits from the scanning device and a position
10 of the mirror have an optical conjugate relationship therebetween.

8. The apparatus according to claim 1, wherein the angle modifying device modifies the pupil incident angle using
15 an optical element common to the angle modifying device and the scanning device.

9. The apparatus according to claim 1, wherein the scanning device includes:
20 a first scanner for scanning the light beam in a first scanning direction; and
a second scanner for scanning the light beam in a second scanning direction intersecting the first scanning direction at a lower speed than the first scanner scans, and wherein the
25 angle modifying device modifies the pupil incident angle using an optical element common to the angle modifying device and the second scanner.

10. The apparatus according to claim 1, wherein a set of the scanning device, the guiding device, and the angle modifying device is provided for each of a pupil of a right eye and a pupil of a left eye of the viewer, and the apparatus further comprising:

a setting device for setting a display position at which the image is displayed in the form of a virtual image in front of the pupils of the eyes, in response to an externally input command; and

a controller for controlling the two angle modifying devices for the pupils of the right and left eyes, respectively, such that two extended center lines intersect each other at the set display position, wherein each of the two extended center lines is defined by extending back the center line of the light beam entering each of the two pupils from a corresponding one of the two guiding devices.

11. The apparatus according to claim 10, wherein the setting device includes:

a sight-line sensor for detecting sight lines of the right and left eyes of the viewer; and

means for setting the display position to a position at which the sight lines detected by the sight-line sensor intersect each other.

12. The apparatus according to claim 10, wherein the

setting device is constituted to set a desired display position of the image to any position in response to manipulation of the viewer.

13. The apparatus according to claim 10, further
5 comprising:

a wave-front-curvature modulator for modulating a wave front curvature of the light beam leaving the light beam generator and entering the scanning device; and

a commanding device for providing a command to the
10 wave-front-curvature modulator to attain a value of the wave front curvature in accordance with a distance from a position of the two pupils to the display position set by the setting device.

14. The apparatus according to claim 11, further
15 comprising:

a wave-front-curvature modulator for modulating a wave-front-curvature of the light beam leaving the light beam generator and entering the scanning device; and

20 means for controlling the wave-front-curvature modulator to attain a value of the wave front curvature in accordance with a distance from a position of the two pupils to a position at which the sight lines detected by the sight-line sensor intersect each other.

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15. The apparatus according to claim 13, wherein the wave-front-curvature modulator includes:

a lens for converging the light beam output by the light beam generator;

a mirror for reflecting the light beam converged by the lens to the scanning device again through the lens; and

5 a distance modifier for modifying a distance between the lens and the mirror, to thereby change the wave front curvature of the light beam.

16. The apparatus according to claim 14, wherein the
10 wave-front-curvature modifier includes:

a lens for converging the light beam output by the light beam generator;

a mirror for reflecting the light beam converged by the lens to the scanning device again through the lens; and

15 a distance modifier for modifying a distance between the lens and the mirror, to thereby change the wave front curvature of the light beam.

17. An apparatus for introducing a light beam into a
20 pupil of an eye of a viewer, to thereby project an image onto a retina of the eye, the apparatus comprising:

a light beam generator for generating and outputting a light beam corresponding to the image;

a scanning device for scanning the light beam output by
25 the light beam generator, including:

a first scanner for scanning the light beam in a first scanning direction; and

a second scanner for scanning the light beam scanned by the first scanner in a second scanning direction intersecting the first scanning direction;

a guiding device for guiding the light beam scanned by the scanning device toward the pupil; and

an angle modifying device for modifying a pupil incident angle at which a center line of a scanning angle of the scanning device enters the pupil, the angle modifying device including a mirror for receiving the light beam scanned by the scanning device, wherein the first and the second scanner have an optical conjugate relationship therebetween, wherein the second scanner and the mirror have an optical conjugate relationship therebetween, and wherein the mirror and a position of the pupil have an optical conjugate relationship therebetween.

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18. The apparatus according to claim 17, wherein the angle modifying device modifies the pupil incident angle using an optical element common to the angle modifying device and the scanning device.

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